UNIVERSITI PUTRA MALAYSIA

COMPUTATIONAL ASSESSMENT OF GROUNDWATER POTENTIAL OFTHE TELUK DATUK - OLAK LEMPIT AQUIFER

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By

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Thesis Submitted in Fulfilment of the Requirements for the Degree of Master of Science in the Faculty of Engineering Universiti Putra Malaysia

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

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June 2000

Chairman: **Associate Professor Dr. Salim b. Said**

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Malaysia is endowed with abundant surface water resources. However, the distribution of the rainfall in time and space has resulted in limited availability of water of acceptable quantity and quality for domestic water use in some parts of the country.

The purpose of this study was to determine areas of groundwater potential and to assess the amount of potentially available groundwater and its quality. It was envisioned that with the proposed development of the groundwater resource in the area, the available surface water and the additional groundwater would meet the domestic need of the people in the area.

Several pumping tests were carried out by Geological Survey Department and Rintisan Sdn. Bhd. at Teluk Datuk – Olak Lempit aquifer. Results of the tests showed that the formation was proven to yield water of considerable quantity.

THWells software was used to calculate the drawdown due to the combined effect of 2 and 4 discharge wells. The results showed that the drawdown could be as high as 18 m if pumping was carried out once a year at 5 MGD pumping rate. The drawdown would cause water from a river nearby to flow into the aquifer but would not affect the quality of well water..

From the results of groundwater quality test, there were two parameters which were higher than the standards. The parameters were Ammonia Nitrogen and Chemical Oxygen Demand. The maximum length of saltwater intrusion was 1.185 km when the nearest wellfield was about 14 to 15 km from the sea. This means the groundwater quality was not affected by the salt- water intrusion.

A three-dimensional finite-difference groundwater flow code known as MODFLOW was used in this study. From the analysis, it could be deduced that the suitable rate of pumping for the study area was 25.5 MGD, which did not affect the surroundings including the Paya Indah wetland. If there was no recharge at all for the whole year, then the suitable rate of pumping was around 10 to 12 MGD only.

With the development of this groundwater project, some of the water supply problems in the Klang Valley can be alleviated. The Teluk Datuk – Olak Lempit aquifer can be developed as a reliable alternative source of water supply.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

TAKSIRAN BERKOMPUTER BAGI POTENSI AIR BAWAH TANAH DI KAWASAN TELUK DATUK – OLAK LEMPIT AKUIFER

Oleh

MOHAMED AZWAN B. MOHAMED ZAWAWI

Jun 2000

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Malaysia kaya dengan sumber air bawah tanah yang tidak digunakan. Walau bagaimanapun, agihan hujan berbanding dengan masa dan kawasan telah menghadkan kedapatan air yang boleh diterima dari segi kuantiti dan kialiti untuk bekalan air bagi sesetengah tempat di negara ini.

Tujuan kajian ini adalah untuk mendapatkan kawasan sumber air bawah tanah yang berpotensi dan menilai jumlah dan kualiti yang ada. Melalui pembangunan sumber air bawah tanah di kawasan tersebut, ia akan dapat dimanafaatkan oleh penduduk di kawasan tersebut.

Beberapa ujian pengepaman telah dijalankan oleh Jabatan Kajibumi dan Rintisan Sdn. Bhd. Di kawasan akuifer Teluk Datuk – Olak Lempit. Hasil kajian menunjukkan akuifer yang dikaji mempunyai kuantiti air yang baik.

Perisian THWells telah digunakan untuk mengira paras susutan yang disebabkan oleh kesan gabungan daripada 2 dan 4 telaga. Hasil kajian menunjukkan bahawa paras susutan boleh mencapai kedalaman 18 m jika dipam pada kadar 5 juta gelen sehari selama setahun. Paras susutan menyebabkan air daripada sungai Langat mengalir masuk ke akuifer tetapi tidak memberi kesan kepada kualiti air telaga.

Daripada hasil analisis kualiti air bawah tanah, dua parameter mempunyai nilai yang lebih tinggi daripada tahap kualiti yang ditetapkan. Parameter tersebut adalah "Ammonia Nitrogen" dan "Chemical Oxygen Demand". Jarak maksimum bagi kemasukan air masin adalah 1.185 km daripada laut sementara kawasan telaga yang terdekat adalah 14 hingga 15 km daripada laut. Ini bermakna tiada kesan kemasukan air masin ke dalam telaga.

Satu program komputer berkaitan air bawah tanah yang dikenali sebagai MODFLOW telah digunakan bagi proses simulasi air bawah tanah. Hasil kajian menunjukkan ianya boleh dicadangkan bahawa kadar pengepaman yang sesuai bagi akuifer Teluk Datuk – Olak lempit adalah 22.5 juta gelen sehari di mana ianya tidak memberi kesan kepada kawasan persekitaran termasuk Tasik Paya Indah. Sekiranya tiada imbuhan air hujan sama sekali selama setahun, adalah dicadangkan kadar pengepaman adalah sekitar 10 hingga 12 juta gelen sehari.

Dengan perkembangan projek air bawah tanah ini, sebahagian masalah bekalan air di Lembah Klang akan dapat diatasi. Akuifer Teluk Datuk – Olak Lempit dikenalpasti boleh dimajukan sebagai sumber alternatif bagi bekalan air

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I certify that an Examination Committee met on 06 June, 2000 to conduct the final examination of Mohamed Azwan b. Mohamed Zawawi on his Master Science thesis entitled "Potential of Groundwater Production in the Teluk Datuk – Olak Lempit Aquifer" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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14 JUL 2000

This thesis was submitted to the Senate of Universiti Putra Malaysia and was accepted as fulfilment of the requirements for the degree of Master Science.

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

(MOHAMED AZWAN B. MOHAMED ZAWAWI)

Date: JUNE 12 , 2000

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS

MGD	Million Gallon Per Day
JPS	Jabatan Pengairan dan Saliran
GSD	Geological Survey Department
KLIA	Kuala Lumpur International Airport
PE	Potential Evapotranspiration
ET	Evapotranspiration
T	Transmissivity
S	Storage Coefficient
OF	Overland Flow
P	Precipitation
S_s	Specific Storage
SR	Shallow Recharge
DO	Dissolved oxygen
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
TDS	Total Dissolved Oxygen

CHAPTER 1

INTRODUCTION

General

There are two sources of water supply available to mankind. One source is the surface water sources which include lakes, streams, drainage, areas which funnel water towards holding reservoirs and all other methods of catching and holding of rain water; and the other source is the groundwater sources, which include wells, springs and horizontal galleries. Actually, surface and ground water sources are not always separate. What is surface water at one point, of the earth may become groundwater at another, then may emerge again as surface water at a third point.

Groundwater is defined as water below the water table in soils and geologic formations that are fully saturated; the pore spaces within the rock or soil matrix are filled or saturated with water (Freeze, 1979). Groundwater occurrence is widespread throughout the humid and the arid regions of the world and in many instances, is the primary or sole source of water for drinking, irrigation, or other uses.

Groundwater used for the water supply schemes must be of acceptable quality and amenable to conventional treatment processes. Generally, the openings through which water flows in the ground are very small. However with increasing urbanization, industrialization and intense agricultural activities, coupled with increased groundwater abstraction rate, the problem of groundwater abstraction rate,

the problem of groundwater quality deterioration can be expected to be aggravated. This is especially so in areas with shallow unconfined alluvial and karstic limestone aquifers. This considerably restricts the rate of flow while at the same time providing a filtering action against particles originally in suspension in the water. These properties, it will be seen, considerably affect the physical, chemical and microbiological qualities of groundwater.

Problem Statement

Recent droughts faced by the country have created water supply problems especially in the Klang Valley. It had caused several major reservoirs in Klang Valley to start drying up to a dangerous level and thus reducing the amount of water permitted for withdrawal. Appendix 1 showed the rainfall and water level of Langat and Semenyih Reservoirs.

According to the Forecast Center in the Meteorological Department in Malaysia, the weather situation faced cannot be called drought. Drought is the situation where there is absolutely no rain. But what happened in Malaysia was hot and dry weather or dry season. It did rain but the amount was not enough to meet the public needs. The El – Nino phenomenon has resulted in the reduction of clouds. Due to that, it rained less. It gets hotter due to sunshine that shines directly on the earth. As a result, the earth rapidly becomes dry and hot. The hot and dry situation in Klang Valley recorded a maximum temperature of 35°C and a minimum of 26°C. Statistics on total rain published by the Meteorological Department, Petaling Jaya has shown an outstanding change in terms of average rain, particularly for stations in Petaling

Jaya and Subang. The Meteorological station in Petaling Jaya has shown that in a three month period, the average of no rainy days was three to four days. As for January, at the meteorological station in Subang, it showed that there was no rain on the 13, 14 and 15 of January. Meanwhile in February, both Meteorological stations in Subang, the no rainy-day period was five days, which was from 7 to 11 March, and in Petaling Jaya, from 27 to 31 March. However, in April, the records in both stations has shown that it did not rain for six days starting from 3 to 8 April. The total rain recorded in both Meteorological stations from January to March has shown that the average monthly rain is increasing between 169.5 mm and 235.9 mm in Subang, and 178 to 266.4 mm in Petaling Jaya. Even though on the average there is quite an increase in monthly rainfall, but the lack of water problem still exists. This is because; it rained only in certain areas. For example, the Semenyih reservoir in Hulu Langat is reported not having rain.

Water supply rationing in Klang Valley was imposed from 27 March 1998 to 20 April 1998 until September for Langat Scheme and Semenyih Scheme. Areas affected were seven districts, which obtained water supply from Langat Scheme and Semenyih Scheme. They are Kuala Lumpur district, Petaling, Gombak, Hulu Langat, Kuala Langat, Sepang and Klang. Plants that could not supply enough water was Semenyih Water Plant, Langat Water Plant, Cheras Water Plant and Ampang Intake Water Plant. About 1.8 million people were affected by the rationing. (Jabatan Bekalan Air, Selangor, 1998).

At the same time, water shortage also has a negative impact on economic growth as manufacturing and commercial activities were affected.

Objectives of the Study

The objective of this study was to assess the groundwater potential and its quality of the Teluk Datuk – Olak Lempit Aquifer. With the potential development of the groundwater resource in the area, it can supplement the available surface water for domestic use.

The specific objectives of this study were:

(1) To analyze the hydraulic properties and potential yield of the production wells and aquifers.

(2) To use THWELLS software to calculate the drawdown resulting from multiple discharge wells based on the Theis and Hantush-Jacob equations for non-steady state flow in confined conditions.

(3) To use Visual MODFLOW to assign the model properties and boundary conditions, run model simulations, calibrate the model and visualize the results with line contours or color shading.

(4) To evaluate potential salt-water intrusion due to pumping at Teluk Datuk-Olak Lempit aquifer.